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who assert that volition is only an empty shadow of the changes which go on in the physical basis. So far as I can see, there can be no compromise between these opinions; and the *modus vivendi* is a device of the men of affairs, with which science has no concern.

Science still has many acute and well-trained enemies, and if they should concentrate their forces in an attack upon biology what better weapon could we place in their hands than our own failure to agree?

Honesty of purpose and expediency unite in the demand that we build biology upon a foundation which can never be shaken; and if we accept as our creed the assertion that while we do not know whether life is or is not different from matter, that while we do not know whether thought is or is not an agent, we should like to find out, we need fear no attack by anything in the universe or outside it.

I am tempted to add a word of comment on one of my letters, as it bears upon the case in point, and is a good illustration of a belief which is held because it cannot be disproved.

It is accompanied by a book in which the writer devotes literary training and skill which many a scientific writer might envy, and eloquence and enthusiasm worthy of any cause, to the thesis that the living world is the work of 'Biologos,' a being who is said to bear about the same relation to us as that which we bear to the plants which we cherish in our gardens from love of horticulture; a being who is very paternal, very loving, very sympathetic and very superhuman, but still very far short of omnipotence or omniscience.

The writer seems to forget that there is no new thing under the sun, and that ages ago the first of naturalists failed to secure appointment as successor to the head of a school where very similar views had been taught, on account of his refusal to advocate

them, not because he thought he could disprove them, but because he held that they are not supported by evidence.

W. K. BROOKS.

JOHNS HOPKINS UNIVERSITY.

*BIBLIOGRAPHY AS A FEATURE OF THE
CHEMICAL CURRICULUM.**

WHEN the Chairman of the Committee on Didactic Chemistry sent me a flattering invitation to address the Chemical Section on some topic associating bibliography with instruction, I hesitated to accept, for it seemed to me that the matter was too obvious to require discussion; but later, as chairman of a committee whose duty it is to encourage, in every possible way and on all occasions, the indexing of chemical literature, I concluded it was my duty to seize the opportunity of saying a few words in favor of introducing bibliographical research into the chemical curriculum of our American colleges. Could this be generally done what a multitude of chemical indexes to special topics might be secured!

The matter is largely in the hands of the heads of the chemical departments in our institutions of learning. As in every branch of instruction, in order to impart to students a lively interest in the subject, the teacher should himself have practical experience in the approved methods of indexing. He might introduce the subject by a lecture on Chemical Literature, pointing out the most recent and the most useful books and serials in the several branches of the science, their special and relative values, and the best way to use them. The teacher might exhibit a sample index in MS., prepared on the index cards of the Library Bureau, and he might explain to those unfamiliar with library cataloguing the technical methods employed. He might also discuss the different ways of

*Read to the Chemical Section of the American Association for the Advancement of Science, Springfield Meeting, August, 1895.

classifying and grouping the data, and show the advantages and disadvantages of the chronological, the author-alphabetical and the topical arrangements. Quite early in the instruction the teacher should direct the attention of the students to the necessity of discrimination between catalogues, bibliographies and indexes, for these words are too often used either as synonyms or indifferently. He should inform the students that a *catalogue* is a list of books on all subjects in a certain collection or locality; that a *bibliography* is a list of the books on a given subject without regard to their position; and that an *index* is a systematically arranged list of the papers and researches on a definite topic contained in books and serials, with references to the same. The teacher might warn the students against regarding the compilation of indexes as drudgery, claiming on the contrary that the task involves an agreeable pursuit similar in its fascination to that of the hunter.

The best methods for securing intelligent work in bibliography may well be left to the judgment of those having charge of instruction. I merely suggest that some institutions find it feasible to require of candidates for the higher degrees in science (B. S., S. D. and Ph. D.) chemical dissertations accompanied by special indexes to the literature of the subjects under discussion. This is a part of the prescribed work for applicants for the degree of Ph. D. at the Corcoran Scientific School of The Columbian University, Washington, a distinction of which the Dean may be justly proud. The preparation of Indexes to Chemical Literature is also required of undergraduates at the University of Michigan by the professor in charge, who is himself a member of the committee of the American Association for the Advancement of Science, already referred to. As a specimen of the excellent work done under Professor Pres-

cott's direction, I may mention the 'Bibliography of Aceto-Acetic Ester,' by Paul H. Seymour, which has been honored by publication in the Miscellaneous Collections of the Smithsonian Institution. (No. 970, Washington, 1894, 148 pp., 8°.) A similar requirement is in force in the chemical departments of Cornell University and of the University of Cincinnati.

The amount and kind of bibliographical work to be required of students will unavoidably vary greatly in different institutions, and must depend in part on the extent of the libraries to which the students have access and in part on their linguistic capacities. In many cases it might be well to limit the requirements to works in the English language, or even to the publications of American chemists, but if thus restricted, completeness within these limits should be insisted upon.

The problem of getting these undergraduate indexes into print is a somewhat difficult one; obviously many would of necessity remain in MS. on the shelves of the college library and become available to a very small number. Some of the more carefully prepared indexes to topics of prime importance would always find channels of publication either in the serials issued by learned societies, in periodicals devoted to analogous subjects, or through the higher medium of the Smithsonian Institution. This difficulty vanishes, however, with respect to those universities that require candidates for higher degrees to *print* their dissertations, as is the custom in most countries of Europe. The U. S. Bureau of Education has furnished me with the following:

**List of Universities and Colleges which require Printed Dissertations before (or after) conferring the degree of Ph. D.: Clark University, Worcester, Mass.; College of New Jersey,*

**Additions and corrections are earnestly desired by the writer.*

Princeton, N. J.; Columbia College, New York City; Cornell University, Ithaca, N. Y.; Johns Hopkins University, Baltimore, Md.; Lake Forest University, Lake Forest, Ill.; Leland Stanford, Jr., University, California; Northwestern University, Evanston, Ill.; University of Colorado, Boulder, Colo.; University of Chicago, Chicago, Ill.; University of Indiana, Bloomington, Ind.; University of Kansas, Lawrence, Kan.; University of Michigan, Ann Arbor, Mich.; University of Minnesota, Minneapolis, Minn.; University of Virginia, Charlottesville, Va.; University of Wisconsin, Madison, Wis.; Vanderbilt University, Nashville, Tenn.; Western Reserve University, Cleveland, Ohio.

Allow me to call attention, in this connection, to the desirability of forming a complete collection of all printed dissertations of American universities, and to suggest that the Smithsonian Institution is the proper place of deposit for such a collection. The Institution already receives those issued by the John Hopkins University and is willing to give others a place. When the magnificent new Library of Congress is completed, a collection of American university dissertations could be well housed, and would make a really valuable addition to the treasury of books; eventually a catalogue of these works could be published, as has recently been done in France. (*Catalogue des Thèses de Sciences, 1810-1890, Albert Maire, Paris, 1892; Catalogue des Thèses de Pharmacie à l'École de Pharmacie de Paris, 1815-1889, Paul Dorveaux, Paris, 1891; Catalogue des Thèses de Pharmacie soutenues en Province, 1803-1894, Paul Dorveaux, Paris, 1895*). It may be proper to state that I am attempting to catalogue all the printed chemical dissertations of American colleges for the *Supplement* to my 'Select Bibliography of Chemistry,' and I appeal to the members of the Chemical Section for assistance.

Finally, could bibliographical researches be introduced into the chemical curriculum of American colleges several advantages would ensue beyond the mere collection of indexes; such a procedure would train students to accuracy in making citations; it would encourage in them a disposition to give credit to earlier workers in the same field of research as their own; it would tend to enlarge their views as to the immense domain of chemical literature; it would lay foundations upon which the post-graduates might build more substantially in after years, and it would develop an appreciation of the historical aspects of chemistry, which busy workers in the laboratory too rarely have opportunities of cultivating.

H. CARRINGTON BOLTON.

AGRICULTURAL CHEMISTRY.*

AGRICULTURAL chemistry is a cosmopolitan science. It was founded by Liebig, of immortal memory. Its early apostle in France was Boussingault; in England, Gilbert; in America, Johnson. It is presumably that science most nearly allied to the sustenance of human life, and thus lies nearer than any other to the heart, or perhaps the stomach, of humanity. Its home is wherever a plant grows. Its devotees are found wherever a plowshare turns the soil. Its base lies in the study of the composition of the soil and the constitution of plants. Its superstructure rises high enough to touch the most abstruse questions of mineral and vegetable physiology and metabolism. Turning from philosophy to facts, we find this science linked indissolubly with the greatest industry of the world. There is scarcely a field or a forest which has not felt the impress of its power. From the field its domain has extended to the factory and the guidance and advice of the

* Read before Section of Chemistry of the American Association for the Advancement of Science, September 3, 1895.